Institut Européen de Chimie et Biologie

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Soutenance de thèse

Biological multi-functionalization and surface nanopatterning of biomaterials.

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The aim of biomaterials design is to create an artificial environment that mimics the *in vivo* extracellular matrix for optimized cell interactions. A precise synergy between the scaffolding material, bioactivity, and cell type must be maintained in an effective biomaterial. In this work, we present a technique of nanofabrication that creates chemically nanopatterned bioactive silicon surfaces for cell studies. Using nanoimprint lithography, RGD and mimetic BMP-2 peptides were covalently grafted onto silicon as nanodots of various dimensions, resulting in a nanodistribution of bioactivity. To study the effects of spatially distributed bioactivity on cell behavior, mesenchymal stem cells (MSCs) were cultured on these chemically modified surfaces, and their adhesion and differentiation were studied. MSCs are used in regenerative medicine due to their multipotent properties, and well-controlled biomaterial surface chemistries can be used to influence their fate. We observe that peptide nanodots induce differences in MSC behavior in terms of cytoskeletal organization, actin stress fiber arrangement, focal adhesion (FA) maturation, and MSC commitment in comparison with homogeneous control surfaces. In particular, FA area, distribution, and conformation were highly affected by the presence of peptide nanopatterns. Additionally, RGD and mimetic BMP-2 peptides influenced cellular behavior through different mechanisms that resulted in changes in cell spreading and FA maturation. These findings have remarkable implications that contribute to the understanding of cell-extracellular matrix interactions for clinical biomaterials applications.

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